

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a process for treating a bitumen froth, wherein the process comprises a solvent  
5 adding step for adding a solvent to the bitumen froth to provide a diluted bitumen froth,  
wherein the process comprises a separating step for separating the diluted bitumen froth into a  
diluted bitumen component comprising bitumen and a diluted tailings component comprising  
water, particulate solids and precipitated asphaltenes, and wherein the process comprises a  
10 solvent recovering step for separating the diluted tailings component into a recovered solvent  
component and a solvent recovered tailings component, the improvement which comprises:

- (a) introducing the diluted tailings component into a solvent recovery apparatus  
following the separating step;
- 15 (b) discharging the solvent recovered tailings component from the solvent recovery  
apparatus as a discharged solvent recovered tailings component; and
- (c) returning a portion of the discharged solvent recovered tailings component to the  
solvent recovery apparatus as a returned solvent recovered tailings component.

20 2. The process as claimed in claim 1 wherein the ratio by volume of the returned  
solvent recovered tailings component to the discharged solvent recovered tailings component is  
no greater than about 5:6.

25 3. The process as claimed in claim 1, further comprising the step of providing a  
moderated pressure in the solvent recovery apparatus.

4. The process as claimed in claim 3 wherein the moderated pressure is between  
about 1 atmosphere and about 2 atmospheres.

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5. The process as claimed in claim 1, further comprising the step of exposing the returned solvent recovered tailings component to shearing conditions before returning the returned solvent recovered tailings component to the solvent recovery apparatus.
- 5 6. The process as claimed in claim 5 wherein the shearing conditions are provided by pumping the returned solvent recovered tailings component with a recycle pump.
7. The process as claimed in claim 1 wherein the solvent recovery apparatus is comprised of a plurality of solvent recovery units configured in series, wherein the solvent recovery apparatus is comprised of a first solvent recovery unit, and wherein the returned solvent recovered tailings component is comprised of a returned portion of the solvent recovered tailings component discharged from the first solvent recovery unit.
- 10 8. The process as claimed in claim 7 wherein the returned portion of the solvent recovered tailings component discharged from the first solvent recovery unit is returned to the first solvent recovery unit.
- 15 9. The process as claimed in claim 8 wherein the ratio by volume of the returned portion of the discharged solvent recovered tailings component from the first solvent recovery unit to the discharged solvent recovered tailings component from the first solvent recovery unit is no greater than about 5:6.
- 20 10. The process as claimed in claim 8 wherein the solvent recovery apparatus is comprised of the first solvent recovery unit and a second solvent recovery unit and wherein the returned solvent recovered tailings component is further comprised of a returned portion of the solvent recovered tailings component discharged from the second solvent recovery unit.
- 25 11. The process as claimed in claim 10 wherein the returned portion of the solvent recovered tailings component discharged from the second solvent recovery unit is returned to the second solvent recovery unit.
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12. The process as claimed in claim 11 wherein the ratio by volume of the returned portion of the discharged solvent recovered tailings component from the second solvent recovery unit to the discharged solvent recovered tailings component from the second solvent recovery unit is no greater than about 5:6.

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13. The process as claimed in claim 1, further comprising the step of thickening at least a portion of the discharged solvent recovered tailings component to produce a thickener underflow component and a thickener overflow component.

10 14. The process as claimed in claim 13 wherein the separating step is performed in a separator apparatus, further comprising the step of returning a portion of the thickener overflow component to the separator apparatus as a returned thickener overflow component.

15 15. The process as claimed in claim 14 wherein the separator apparatus is comprised of a plurality of separator units configured in series and wherein the returned thickener overflow component is distributed to one or more of the separator units.

16. The process as claimed in claim 13, further comprising the separating step, wherein the separating step is comprised of the following steps:

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(a) first separating the bitumen froth into a first separating stage overflow component and a first separating stage underflow component;

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(b) adding a solvent to the first separating stage underflow component to provide a diluted first separating stage underflow component;

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(c) second separating the diluted first separating stage underflow component into a second separating stage overflow component and a second separating stage underflow component, wherein the second separating stage underflow component is comprised of the diluted tailings component;

- (d) returning the second separating step overflow component to the first separating step so that the second separating step overflow component mixes with the bitumen froth to provide the diluted bitumen froth.

5 17. The process as claimed in claim 16, further comprising the step of returning a portion of the thickener overflow component to the separating step as a returned thickener overflow component.

10 18. The process as claimed in claim 17 wherein the returned thickener overflow component is returned to one or both of the first separating step and the second separating step.

19. The process as claimed in claim 18 wherein the first separating step is performed at a temperature which is lower than a temperature at which the second separating step is performed.

15 20. The process as claimed in claim 18 wherein the first separating step is performed at a temperature and wherein the second separating step is performed at a temperature, further comprising the step of providing a heat input to the second separating step in order to control the temperature of the first separating step and the temperature of the second separating step.

20 21. In a process for treating a bitumen froth, wherein the process comprises a solvent adding step for adding a solvent to the bitumen froth to provide a diluted bitumen froth, wherein the process comprises a separating step for separating the diluted bitumen froth into a diluted bitumen component comprising bitumen and a diluted tailings component comprising  
25 water, particulate solids and precipitated asphaltenes, and wherein the process comprises a solvent recovering step for separating the diluted tailings component into a recovered solvent component and a solvent recovered tailings component, the improvement which comprises:

30 (a) introducing the diluted tailings component into a solvent recovery apparatus following the separating step;

(b) discharging the solvent recovered tailings component from the solvent recovery apparatus as a discharged solvent recovered tailings component; and

5 (c) thickening at least a portion of the discharged solvent recovered tailings component to produce a thickener underflow component and a thickener overflow component.

22. The process as claimed in claim 21 wherein the separating step is performed in a separator apparatus, further comprising the step of returning a portion of the thickener overflow  
10 component to the separator apparatus as a returned thickener overflow component.

23. The process as claimed in claim 22 wherein the separator apparatus is comprised of a plurality of separator units configured in series and wherein the returned thickener overflow component is distributed to one or more of the separator units.

15 24. The process as claimed in claim 21, further comprising the separating step, wherein the separating step is comprised of the following steps:

20 (a) first separating the bitumen froth into a first separating stage overflow component and a first separating stage underflow component;

(b) adding a solvent to the first separating stage underflow component to provide a diluted first separating stage underflow component;

25 (c) second separating the diluted first separating stage underflow component into a second separating stage overflow component and a second separating stage underflow component, wherein the second separating stage underflow component is comprised of the diluted tailings component;

- (d) returning the second separating step overflow component to the first separating step so that the second separating step overflow component mixes with the bitumen froth to provide the diluted bitumen froth.

5 25. The process as claimed in claim 24, further comprising the step of returning a portion of the thickener overflow component to the separating step as a returned thickener overflow component.

10 26. The process as claimed in claim 25 wherein the returned thickener overflow component is returned to one or both of the first separating step and the second separating step.

15 27. The process as claimed in claim 26 wherein the first separating step is performed at a temperature which is lower than a temperature at which the second separating step is performed.

20 28. The process as claimed in claim 26 wherein the first separating step is performed at a temperature and wherein the second separating step is performed at a temperature, further comprising the step of providing a heat input to the second separating step in order to control the temperature of the first separating step and the temperature of the second separating step.

29. An apparatus for treating a bitumen froth comprising:

25 (a) a solvent recovery apparatus for separating a diluted tailings component recovered from the bitumen froth into a recovered solvent component and a solvent recovered tailings component;

30 (b) a discharge outlet for discharging the solvent recovered tailings component from the solvent recovery apparatus as a discharged solvent recovered tailings component; and

- (c) a return line for returning a portion of the discharged solvent recovered tailings component to the solvent recovery apparatus as a returned solvent recovered tailings component.

5 30. The apparatus as claimed in claim 29 wherein the solvent recovery apparatus is comprised of a plurality of solvent recovery units configured in series, wherein the solvent recovery apparatus is comprised of a first solvent recovery unit and wherein the return line is comprised of a first return line which is adapted to return to the first solvent recovery unit a portion of the solvent recovered tailings component which is discharged from the first solvent  
10 recovery unit.

31. The apparatus as claimed in claim 30 wherein the first solvent recovery unit comprises a first discharge outlet for discharging the solvent recovered tailings component from the first solvent recovery unit, further comprising a first shear apparatus associated with the first  
15 discharge outlet for shearing the solvent recovered tailings component which is discharged from the first solvent recovery unit.

32. The apparatus as claimed in claim 31 wherein the solvent recovery apparatus is further comprised of a second solvent recovery unit and wherein the return line is further  
20 comprised of a second return line which is adapted to return to the second solvent recovery unit a portion of the solvent recovered tailings component which is discharged from the second solvent recovery unit.

33. The apparatus as claimed in claim 32 wherein the second solvent recovery unit  
25 comprises a second discharge outlet for discharging the solvent recovered tailings component from the second solvent recovery unit, further comprising a second shear apparatus associated with the second discharge outlet for shearing the solvent recovered tailings component which is discharged from the second solvent recovery unit.

30 34. The apparatus as claimed in claim 29, further comprising a thickener vessel associated with the solvent recovery apparatus for thickening at least a portion of the discharged

solvent recovered tailings component to produce a thickener underflow component and a thickener overflow component.

35. The apparatus as claimed in claim 34 wherein the solvent recovery apparatus is associated with a separator apparatus for separating the bitumen froth into a diluted bitumen component and the diluted tailings component, further comprising a thickener return line for returning at least a portion of the thickener overflow component to the separator apparatus as a returned thickener overflow component.

36. An apparatus for treating a bitumen froth comprising:

(a) a solvent recovery apparatus for separating a diluted tailings component recovered from the bitumen froth into a recovered solvent component and a solvent recovered tailings component;

(b) a discharge outlet for discharging the solvent recovered tailings component from the solvent recovery apparatus as a discharged solvent recovered tailings component; and

(c) a thickener vessel associated with the solvent recovery apparatus for thickening at least a portion of the discharged solvent recovered tailings component to produce a thickener underflow component and a thickener overflow component.

37. The apparatus as claimed in claim 36 wherein the solvent recovery apparatus is associated with a separator apparatus for separating the bitumen froth into a diluted bitumen component and the diluted tailings component, further comprising a thickener return line for returning at least a portion of the thickener overflow component to the separator apparatus as a returned thickener overflow component.



38. A process for treating tailings to recover therefrom a clarified overflow component, an unclarified overflow component and an underflow component, comprising the following steps:

- 5 (a) introducing the tailings into a thickener vessel;
- (b) withdrawing the underflow component from a lower level of the thickener vessel;
- 10 (c) withdrawing the clarified overflow component from an intermediate level of the thickener vessel; and
- (d) withdrawing the unclarified overflow component from an upper level of the thickener vessel.

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39. The process as claimed in claim 38 wherein the thickener vessel is comprised of a sidewall and wherein the tailings are introduced into the thickener vessel at a location which is in spaced relation to the sidewall.

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40. The process as claimed in claim 39 wherein the sidewall defines a thickener area and wherein the tailings are introduced into the thickener vessel at a central location within the thickener area.

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41. The process as claimed in claim 40 wherein the tailings are introduced into the thickener vessel at the intermediate level of the thickener vessel.

42. The process as claimed in claim 29, further comprising the step of distributing the tailings within the thickener vessel after they are introduced into the thickener vessel.

43. The process as claimed in claim 41 wherein the distributing step is comprised of introducing the tailings into the thickener vessel so that they contact a distributor apparatus located within the thickener vessel.

5 44. The process as claimed in claim 40 wherein the clarified overflow component is withdrawn from the thickener vessel adjacent to the sidewall of the thickener vessel.

45. The process as claimed in claim 40 wherein the unclarified overflow component is withdrawn from the thickener vessel adjacent to the sidewall of the thickener vessel.

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46. The process as claimed in claim 45, further comprising the step, prior to withdrawing the unclarified overflow component from the thickener vessel, of collecting the unclarified overflow component in a launder adjacent to the sidewall of the thickener vessel.

15 47. The process as claimed in claim 44 wherein the unclarified overflow component is withdrawn from the thickener vessel adjacent to the sidewall of the thickener vessel.

48. The process as claimed in claim 47, further comprising the step, prior to withdrawing the unclarified overflow component from the thickener vessel, of collecting the  
20 unclarified overflow component in a launder adjacent to the sidewall of the thickener vessel.

49. The process as claimed in claim 47, further comprising the step of adding a flocculant to the tailings.

25 50. The process as claimed in claim 47, further comprising the step of passing a gas upwards through the tailings within the thickener vessel.

51. The process as claimed in claim 50 wherein the gas is passed upwards through the tailings between the sidewall and the central location within the thickener area so that the  
30 clarified overflow component may pass through the gas before being withdrawn from the thickener vessel.

52. The process as claimed in claim 51 wherein the gas is comprised of air.

53. The process as claimed in claim 47 wherein the clarified overflow component  
5 encounters a baffle arrangement located within the thickener vessel in order to still the clarified  
overflow component before it is withdrawn from the thickener vessel.

54. A thickener vessel comprising:

10 (a) a sidewall defining a lower level of the thickener vessel, an intermediate level of  
the thickener vessel and an upper level of the thickener vessel;

(b) a feedwell for introducing tailings into the thickener vessel;

15 (c) at least one underflow outlet in communication with the lower level of the  
thickener vessel for withdrawing an underflow component from the thickener  
vessel;

20 (d) at least one clarified overflow outlet in communication with the intermediate  
level of the thickener vessel for withdrawing a clarified overflow component  
from the thickener vessel; and

25 (e) at least one unclarified overflow outlet in communication with the upper level of  
the thickener vessel for withdrawing an unclarified overflow component from  
the thickener vessel.

55. The thickener vessel as claimed in claim 54 wherein the feedwell is located in  
spaced relation to the sidewall.

30 56. The thickener vessel as claimed in claim 55 wherein the feedwell extends from  
the upper level of the thickener vessel to the intermediate level of the thickener vessel so that

the tailings are introduced into the thickener vessel at the intermediate level of the thickener vessel.

57. The thickener vessel as claimed in claim 56 wherein the sidewall defines a  
5 thickener area and wherein the feedwell is located at a central location within the thickener area.

58. The thickener vessel as claimed in claim 57 wherein the clarified overflow outlet  
is located adjacent to the sidewall.

10 59. The thickener vessel as claimed in claim 57 wherein the unclarified overflow  
outlet is located adjacent to the sidewall.

60. The thickener vessel as claimed in claim 59, further comprising a launder  
15 located at the upper level of the thickener vessel and adjacent to the sidewall for collecting the  
unclarified overflow component, wherein the unclarified overflow outlet is in communication  
with the launder.

61. The thickener vessel as claimed in claim 58 wherein the unclarified overflow  
20 outlet is located adjacent to the sidewall.

62. The thickener vessel as claimed in claim 61, further comprising a launder  
located at the upper level of the thickener vessel and adjacent to the sidewall for collecting the  
unclarified overflow component, wherein the unclarified overflow outlet is in communication  
25 with the launder.

63. The thickener vessel as claimed in claim 58, further comprising a sparge  
apparatus for passing a gas upwards through the tailings within the thickener vessel.

30 64. The thickener vessel as claimed in claim 63 wherein the sparge apparatus is  
located within the thickener vessel between the sidewall and the feedwell.

65. The thickener vessel as claimed in claim 64 wherein the sparge apparatus is located within the thickener vessel between the clarified overflow outlet and the feedwell so that the clarified overflow component may pass through the gas before being withdrawn from the thickener vessel.

66. The thickener vessel as claimed in claim 63 wherein a plurality of clarified overflow outlets are distributed around the sidewall.

10 67. The thickener vessel as claimed in claim 66 wherein the sparge apparatus is located within the thickener vessel between the plurality of clarified overflow outlets and the feedwell so that the clarified overflow component passes through the gas before being withdrawn from the thickener vessel.

15 68. The thickener vessel as claimed in claim 55, further comprising a distributor apparatus for distributing the tailings within the thickener vessel after they are introduced into the thickener vessel.

20 69. The thickener vessel as claimed in claim 68 wherein the distributor apparatus is comprised of a distributor plate.

70. The thickener vessel as claimed in claim 65, further comprising a baffle arrangement located within the thickener vessel between the sparge apparatus and the clarified overflow outlet, for stilling the clarified overflow component before it is withdrawn from the thickener vessel.